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FINDINGS OF OFFICIAL NATIONWIDE INVESTIGATION OF CONDITIONS OF LOCOMOTIVES IN CHINA

A. Course of Investigation

This investigation, with an appraisal of the findings, was made in the course of a thorough and systematic examination of the rolling stock of the railways of the whole country. It was undertaken to ascertain the actual condition of the locomotives, to learn the relative status of the various railway bureaus and divisions with respect to their motive power, to find out about the performance, maintenance, inspection, and repairs of the locomotives, and to discover the good and the bad in locomotive operation.

This task of investigation and appraisal is of considerable significance because it can serve as a basis and guide for formulating practical plans for routine inspections and repairs, for estimating requirements as to materials for repairs and replacements, for deciding on work policies, improving methods, and raising the average quality level of the locomotives; in fact it can affect all phases of operations.

In the fall of 1949, the Northeast Railway Administration, having got the idea from the USSR, carried out an investigation of the locomotives in all the bureaus of the Northeast. Subsequently, in a national conference of railway shop superintendents and division chiefs, it was decided to organize inspection groups in all the bureaus in north and south China to make this special study. (The Heng-yang Railway Bureau did not participate in this study because it was in an area which at that time was in the throes of liberation.)

It was decided to limit the study to locomotives in actual use, to note the condition of each locomotive with steam up just previous to a routine Class B and Class C inspections, and again following a routine inspection and repair job before firing the locomotive boiler. The work, beginning in November 1949, was to be carried on energetically with the aid of members of the class for training purchasing inspectors conducted by the Ministry of Railways, and was to be completed in January 1950.

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[Note: Classification of inspection and repair jobs, based on information found in Chinese mainland newspapers at various times, affairs to be as follows:

Class A inspection and repair (chia-chien) -- a thorough-going inspection and repair job made after 60,000 kilometers of operation, or every 6 months

Class B inspection and repair (i-chien) -- inspection and attention to slight repairs once each month

Class C inspection and repair job (ping-chien) -- inspection and repair of minor defects every 60 days]

Under the direction of the Division of Rolling Stock of the ministry, representatives from each of the railway bureaus then spent a month studying the data collected concerning each individual locomotive. The bureaus of the Northeast Railway Administration and the Tsinan Railway Bureau turned in the best reports. Their reports were complete, clear, and in good order. However, it must be pointed out that inadequate preparations for the study had been made, instructions were not sufficiently clear and explicit, and instruments for inspection were not adequate. Some of the bureaus did not take the matter seriously enough, they were dilatory in completing and reporting their inspections, they omitted replies to some of the items on the questionaire.

Regarding such important items as degree of corrosion, and thickness of boiler plates, the T'ai-yuan, Shanghai, Tientsin, and Cheng-chou bureaus made no inspections, and their answers to conditions were not explicit. Some returns did not submit diagrams of the locomotive boilers. This all goes to show that there were still many deficiencies on the part of workers in the bureaus. Notwithstanding these failings, the data gathered concerning the condition of all the locomotives of the country may be classified according to the following standards or categories, and thereby a distinct idea can be gained of the general situation as to the condition of the nation's locomotives.

The standards, or categories, are as follows:

1. Standards for First-Class Locomotives

a. Dimensions of all parts do not vary more than the first limit of permissible variation.

b. Flue plates and ceiling plates are without pits or cracks.

c. No single plate of the boiler is patched more than 3 times.

d. Boiler plates are free from corroded or otherwise unsound spots.

e. Boiler plates are without convexities and concavities.

f. Boiler does not leak

g. Boiler condition is good as regards scale.

2. Standards for Medium-Class Locomotives

a. Dimensions of all parts do not vary more than the second limit of permissible variation.

b. Condition is such that it would be remedied in the course of a routine Class A inspection and repair job.

c. Condition of fire tubes is such that not more than 30 tubes require repairs that would be taken care of in a routine Class A inspection and repair job.

3. Standards for Fair-Class Locomotives

a. Dimensions of important parts do not vary more than the third limit of permissible variation.

b. Condition of boiler is such that it can be remedied in a medium-class repair job.

c. Large and small fire tubes as a whole are badly deteriorated.

4. Standards for Poor-Class Locomotives

a. Variation in dimensions of important parts exceed the third limit of permissible variation.

b. Condition of boiler is such that it requires more than a medium-class repair job.

B. General Situation

This investigation is especially characterized by its broad scope, since it embraced investigations in ten railway bureaus and 17 divisions, involving 2,082 locomotives in active use plus 110 available for use, which were of 25 different types or models. The ratio between the number of locomotives included in the investigation and the total number of locomotives assigned to each bureau, or division, respectively, was as follows:

Bureau	Percent	Bureau	Percent
Tientsin	85.6	Tsinan	97.8
Cheng-chou	80.1	T'ai-yuan	82.5
Shanghai	73.8	Harbin	84.7
Kirin	86.2	Ch'i-ch'i-ha-erh	71.7
Chin-chou	71.3	Mukden	88.7

General average 83.6 percent

In the investigation, the Cheng-chou and Shanghai bureaus did not report the age of their locomotives. The number for which ages were reported was 909. The average age of the 909 locomotives was 16.1 years.

Locomotives whose average age was lowest included:

	Average Age (yr)
Mikado No 1	11.5
Mikado No 6	11.8
Pacific No 6	12.1

The types averaging oldest were Decapod No 2 and American No 2.

The average age for each bureau was as follows:

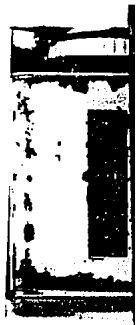
Bureau	Years	Bureau	Years
Tsinan	8.8	Chin-chou	15
Kirin	13.6	Mukden	16
Harbin	14.4	Tientsin	21.5
T'ai-yuan	25.7	Ch'i-ch'i-ha-erh	14.6

In the Cheng-chou and Shanghai bureaus which did not report the ages of their locomotives, 58 percent are of the Mikado type; these locomotives do most of the freight work of those bureaus. Next are the Pacific type which constitute 12 percent of all the locomotives in the country. The Consolidation type and other miscellaneous types constitute 21 percent. These are used mainly in the areas under the Shanghai and T'ai-yuan bureaus for freight and passenger train service.

C. Findings

The general condition of the locomotives of the country is not good, only 7.1 percent being in first-class condition. The number in poor condition is 10.4 percent; in fair condition, 47.2 percent; in medium condition, 35.3 percent. The number in first-class and medium-class condition is only 42.4 percent, while those in fair and poor condition is 57.8 percent. This is the basic condition of the locomotives of the country. The bureau with locomotives in the best condition is Tsinan, having 57.17 percent in first-class and medium-class condition; Shanghai is next with 55 percent. The relative grading of locomotives in the various bureaus is as follows:

Bureau	1st Class (%)	Medium (%)	Fair (%)	Poor (%)
Tientsin	6.6	36.0	43.6	13.8
Tsinan	8.17	49.0	38.4	4.5
Cheng-chou	2.5	37.8	39.5	20.2
T'ai-yuan	1.5	24.8	52.6	21.1
Shanghai	10.1	44.9	37.9	6.94
Harbin	16.5	33.9	31.0	18.8
Ch'i-ch'i-ha-erh	14.0	37.0	35.5	12.5
Kirin	1.6	12.0	54.0	32.0
Mukden	9.9	35.0	37.0	18.16
Chin-chou	7.0	38.0	45.0	8.0
Average	7.1	35.3	47.2	10.8



As to types or models, Mccs, Consolidation M, Mikado No 1, Mikado No 3, Mikado No 4, and Pacific No 6, were found to be in comparatively better condition. The results in tabulated form are as follows:

Type	1st Class (%)	Medium (%)	Fair (%)	Poor (%)
Mikado No 1	7.1	48.5	36.8	7.6
Mikado No 3	9.1	72.7	18.2	0.0
Mikado No 4	0.0	100.0	0.0	0.0
Consolidation M	7.7	84.6	7.7	0.0
Mccs	11.8	70.6	13.7	3.9
Pacific No 6	13.8	46.0	34.0	5.7

Of the above types, those in first-class and middle-class condition constituted over 50 percent, and there were more in medium condition than in fair condition. Of the other types of locomotives, those in first-class and medium-class condition constituted less than 50 percent.

With respect to types and ages, the situation in the Kirin Bureau is not at all bad, the average age of the locomotives being 13.3 years, [sic, 13.6 years according to preceding table] which is better than the figures of the Harbin, Ch'i-ch'i-ha-erh, Chin-chou, Mukden, Tientsin, and T'ai-yuan bureaus. Of Kirin's locomotives, 71 percent are Mikado No 1 type, with very few of miscellaneous models, a status which is better than that of any other bureau in China, inside or outside of the Great Wall.

However, in the grading of the condition of locomotives, Kirin was found to be in the worst condition. This shows that the most important factor in the grading of locomotives is not the type, nor age, but how the locomotive is used, and the care given to its maintenance, inspection, and repair.

For comparison of the divisions, let us say that a first-class division is one having 60-70 percent of its locomotives in first- and medium-class condition; a second-class division is one with 50-60 percent in first- and medium-class condition; a third-class division is one with less than 50 percent in first- and medium-class condition; and a fourth-class division is one with less than 50 percent in first- and medium-class condition and with more than 30 percent of the locomotives in poor condition.

According to this grading, the Kirin Bureau has no first-class divisions, only 10 percent of its divisions can be graded as second class, 40 percent must be graded as third class, and 50 percent must be graded as fourth class. The T'ai-yuan Bureau has no first-class divisions, only 16.69 percent of its divisions can be graded as second class, 50.00 percent of its divisions must be graded as third class, and 33.2 percent must be graded as fourth class. The situation in the Cheng-chou bureau is also very bad; more than 50 percent of its divisions must be graded as third class, and 33 percent as fourth class.

On the basis of the grading of divisions indicated above, the divisions may be arranged into four classes as follows:

Bureaus	No of Locomotives	Defective Plates: No of Locomotives	Defective Plates: Percent	Defective Stay Bolts, Tubes: No of Locomotives	Defective Stay Bolts, Tubes: Percent
Northeast	1,005	343	34.1	--	--
Tientsin	275	239	86.9	89	32.4
Tsinan	269	173*	64.3	51	18.9
Cheng-chou	238	132	55.4	144	60.5
T'ai-yuan	137	137	100.0	80	58.4
Shanghai	158	44	27.8	64	40.5
Total	2,082	1,068	51.3	428	39.8
				(Without Northeast)	

* This figure includes three locomotives which are immobile.

In addition to the defective condition of the boilers, wear on moving parts of the locomotives is another matter where bad conditions exist. The average wear on the surface of locomotive wheel tires is 1.52 millimeters, and the average thickness of the wheel tires was found to be 52.8 millimeters. The tires on 973 locomotives ought to be changed. In particular, the tires on the locomotives of the T'ai-yuan Bureau average only 46.9 millimeters in thickness, nearly down to the third limit of variation. The thickness of tires on the driving wheels of 343 locomotives was found to be less than 40 millimeters; this is 15.9 percent of the locomotives investigated. On 796 locomotives, or 37 percent of the whole number, the tire thickness is less than 55 millimeters. At a time when it is difficult to get the material for locomotive tires, the tires of a large number of locomotives should be changed at once, and an even larger number of locomotives are approaching the point where the tires must be changed. This situation presents a grave problem.

D. Analysis of Quality

The deteriorated condition of the locomotives, particularly of boilers and moving parts, can be attributed chiefly to the following considerations:

1. In the matter of inspections and repairs, we have not secured the results called for by the regulations pertaining to systematic inspections and repairs. According to the statistics for 1949, the actual mileage covered by the locomotives was greater than the permissible mileage corresponding to the inspections and repairs actually made. In fact, it was a common occurrence for the mileage run between successive Class B and Class C inspections to be greatly extended beyond normal. For example, the following table shows the 1949 figures for the Northeast in terms of the number of inspection and repair jobs actually made on locomotives, compared with the number of repair jobs scheduled for the year on the basis of standard mileage of operation.

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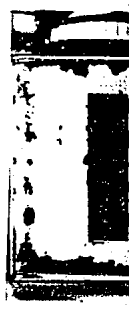

Process	Repair Jobs Scheduled*	Repair Jobs Actually Made	Percent of Scheduled Jobs Completed
Major overhaul	109	148	135.8
Medium overhaul	217	138	63.6
Class A inspection and repair	650	507	78.0
Class B inspection and repair	6,157	6,290	102.2
Class C inspection and repair	7,915	6,492	82.0

* Based on mileage

2. The quality of inspection and repair work performed in the shops and on the division was low. In the major and medium overhaul jobs, the scale inside the boilers and pipes was not always completely removed, frequently broken stay bolts were not taken out and replaced, so that the plated bulged, as happened on 1 July in the case of Mikado type locomotive No 672 of the Tientsin Bureau. Sometimes the corroded or otherwise unsound parts of a plate are not all removed before patching a hole according to prescribed techniques. The electric welding jobs often reveal poor workmanship, resulting in great damage to the boiler. Sometimes three or even four patches are made on the same piece of boiler plate.

3. In the past, not enough attention has been given to Class B and Class C inspection and repair jobs. The system in use of contracting with a team of workmen for a particular repair job is imperfect. Often the work thus done is not properly planned or executed, and upon completion is not carefully examined and approved. Often the doors to firebox and ash box do not close tightly nor stay closed, and in numerous other particulars technical standards of work are violated. Improper blowing out of the boiler is one of the principal causes of the poor condition of our locomotive boilers.

4. There has been carelessness in the operation and care of locomotives. Operators do not take proper care of the valuable mechanisms entrusted to them. They do not observe good practice with respect to the admission of cold water to the boiler, the use of forced draft, the adding of coal and the stoking of the fire. Technically deficient engineers frequently race the wheels, speed control is wasteful, harsh use of brakes is a common fault. Crews are not careful as to equal distribution of loads upon the axles. For these and other reasons, the uneven wear on the tires is very damaging to the driving wheels.

5. There has been failure to implement a system of specific responsibility for the care of locomotive boilers and wheels. In the past this was regarded as of little importance, but even since it was put into effect, it is not observed with sufficient strictness.

The results of this investigation indicate that there are real grounds for alarm concerning the condition of the country's locomotives. If adequate measures are not taken promptly to improve the quality of the locomotives, of inspection and repair, and methods of operation, the situation will become worse. To remedy this situation and reverse the downward trend, it is necessary to effect the following measures.

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1. During 1960, increase the frequency of routine inspections and repairs, carry them out systematically and promptly. Complete as soon as possible the overhauls and repair jobs which this investigation has revealed to be necessary, namely, thorough overhaul of 122 locomotives, medium overhaul of 334 locomotives, Class A repair jobs on 731 locomotives. Replace, as soon as possible, important parts which require replacement, including 973 tires of driving wheels, 560 tires of tender wheels, 3,563 large flues, 23,255 small fire tubes, 178 bent door fastenings.

2. Raise the quality of work done on inspection and repair jobs by

a. Establishing a better system of inspection after repairs are made and before acceptance, check up on the repair work to see that performance is satisfactory.

b. Raising the level of competence of the post-repair inspectors, technically, ideologically, and with regard to their sense of responsibility to the people's railways and to the people.

3. Put into effect plans for more efficient work on Class B and Class C inspection and repair jobs, which are the crux of preserving and bettering the condition of our locomotives. In determining the frequency of such inspections, and scheduling them, the quality of the water supply should be taken into account. The periods or mileage between inspections positively should not be too great.

The prescribed procedure and methods to be followed in blowing out the boilers should be scrupulously observed. The foreman of the crews doing this work should be experienced and conscientious men. The locomotive crews should take part in Class B and Class C inspections. The division chiefs should systematically check up on these inspections. When a repair job is finished and the preacceptance examination is made, the examining inspector, the foreman of the repair gang, the foreman of the boiler cleaning gang, and the engineer of the locomotive concerned should all participate in the various phases of the examination. Furthermore, the equipment for supplying adequate hot water to clean the boilers should be installed as early as possible.

4. In each bureau a system of special responsibility should be established, that is, men should be trained for specific tasks and then held responsible for them.

5. Train the locomotive crews in more careful, conscientious, and technically efficient operation and care of locomotives. This will have a great deal to do with extending the life of the locomotives.

6. Improve the quality of the water supply. In too many places, at present, the quality of the water is unsuitable. Water-softening equipment should be installed and put into active use as soon as possible in every place where it is advisable. This will help solve one of the fundamental problems related to locomotive boilers.

7. Adopt and put into effect a policy of making semiannual nationwide investigations of locomotive conditions. Set up a system of awards and penalties based on the findings of these investigations. Make preparations for the second nationwide investigation. Announcement will be made later concerning the forms to be used in making reports of investigations.

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